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ABSTRACT

Neither video technology nor computer technology has had the impact on formal education that many had predicted. Both media have enormous and growing potential for this purpose however. Instructional packages that can be used as supplementary material to teaching seems the most appropriate approach to develop for higher education. Video modules enlarge the audience for special material, make available inaccessible material, and perform self analysis and evaluation. Computer based modules offer interactive testing of accumulated knowledge, self-paced analysis and investigation, and gaming. The primary obstacles to the use of these technologies are the absence of a viable system for distribution and access, the limited technological resources of the schools, and the lack of adequate incentives for authors of such modules. One force acting to overcome these obstacles is EDUCOM. Since it was established in 1964, EDUCOM has attempted to help create a national computer network, provide information to improve computing services within individual universities and colleges, and provided a forum for higher education institutions to speak to the Federal Government on the subject of educational computing. (JY)

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Modular Instructional Materials: Video and Computer Packages

Joe B. Wyatt

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With the development of radio and television and later, since the development of the early digital computers in the 1950's, people have used electronic technologies for learning. As communications technology has improved, the exposure of people to information processed and delivered via the technological media has reached most of the population of the United States.

Traditional education has relied heavily on personal contact between the teacher and the student. Prior to the advent of printing technology, personal verbalization and demonstration of concepts and ideas were the exclusive methods for educational communication. Printing technology brought with it the ability to establish indirect forms of contact. The distribution of carefully prepared printed material allowed a much more widespread dissemination of concepts and ideas where total personal contact was not required. Printing technology has had hundreds of years to become established as a means of delivering instructional material. Reading skills are emphasized from a very early age in order to maximize the effectiveness of printing technology. Printing technology has thus become an important and essential form of "leverage" for teachers to communicate material to students.

Electronic technology in the form of audio systems, video systems, and computer systems bring powerfully different forms of leverage. Although audio and video technology are passive, in a manner similar to books, they

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have some inherent advantages over printed material. The leverage is similar to that of books but provides an important new perspective, e.g., sounds and sights. Computer technology is different in that it is not passive. Through the use of stored program "software", digital computer systems can be programmed to interact with people as well as perform feats of computation and information processing. Moreover, computer technology can be used in conjunction with the audiovisual and printing technologies. It is this concept that seems to have enormous potential.

TECHNOLOGY AND TEACHING

Currently, all of these technologies are being used at increasing rates to process and deliver information to people. For example, over the two decade period since 1950 the annual number of additions of printed matter at university libraries quadrupled on the average. At the same of expansion it will have multiplied sixteen fold from its 1950 level in two more decades.[1] Broadcast television (primarily as an entertainment medium) is now represented by television sets in over 90,000,000 American households. Over ten million of these television households are on cable television,[2] the medium which offers "two-way" communication capability and has promised to marry computer technology and audiovisual technology. As a part of this growth, instructional television (ITFS) stations are flourishing under licenses granted by the Federal Communications Commission. Also in the past two decades, the number of stored program digital computers in use in the United States has increased

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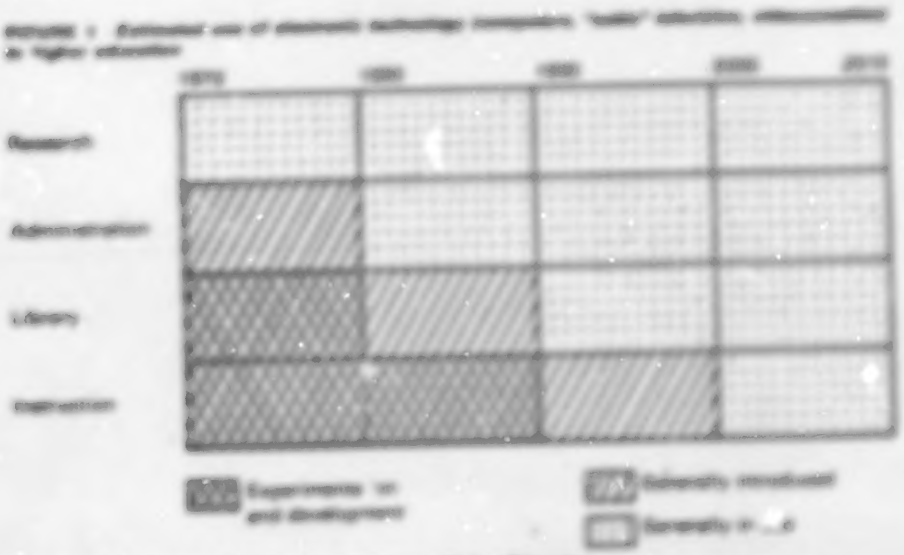
1. Baumol, Wm. J. and Marcus, Matityahu, Economics of Academic Libraries, American Council on Education, 1973, p 13.

2. "Cable Data", Cable Television Information Center, The Urban Institute, Washington, D.C., 1974.

from a handful to over 1 million with a near exponential growth rate that is continuing to increase. Thousands of these computer systems are in colleges and universities. Mini and micro computer technology promises to lower the cost and improve the versatility of computer based systems enough to accelerate this already explosive growth, e.g., programmable hand-held calculators.

One can argue that we have enormous technological power for teaching. We are not, however, using the power at a level approaching its potential. The neoclassical Carnegie Commission study indicates that the experience with technology (applied to instruction) as compared with the hopes of its early supporters suggests that "it is a) coming along more slowly, b) costing more money, and c) adding to rather than replacing older approaches -- as the teacher once added to what the family could offer, as writing then added to oral instruction, as the book later added to the handwritten manuscript".[3] The Carnegie work also concluded that the use of these technologies in instruction is substantially trailing the primary uses in universities which (in chronological order) have been research, administration and the library[4] (see Figure 1). Now, five years later, their predictions are not obviously overly pessimistic.



3. The Fourth Revolution: Instructional Technology in Higher Education, Carnegie Commission on Higher Education, June, 1972.

4. Ibid p 2.

With the increase in the numbers of students in colleges and universities in the past two decades, educational principles as practiced in teaching [illegible] changed. The ratio of teaching faculty to students has become sufficiently small that there is often little opportunity for individual interaction between student and teacher, particularly at the undergraduate level. Students are taught by other students with diminished opportunities for informal discourse. Faculty teaching is further reduced by research, administrative appointments and other non-teaching activities. Adding to the problem are two important factors: the amount of knowledge which should be delivered to a student in the time period available continues to increase sharply, and if the "financial crunch" is alleviate is spending more productivity of the teaching process.

TECHNOLOGY-BASED INSTRUCTIONAL PACKAGES

Neither video technology nor computer technology has had the impact in the formal education that many had predicted. Both medium have enormous untapped growing potential for this purpose, however. There are a number of factors affecting the use of instructional technology, and most have been thoroughly discussed before. The thesis of this work is that the concept of modular instructional packages which can be used as supplementary material is technology is the most appropriate area to develop for higher education. The strategy appears to be about right. Many of the opportunities are already [illegible], but there continues to be obstacles as well. In the following paragraphs, some opportunities for the coordination of electronic technologies in technology are discussed from the point of view of the modular instructional supplementation, some of the major obstacles are described in a prescriptive manner. Finally, the efforts and plans of IBMCAD which relate to these opportunities and problems are briefly introduced.

Video Projects

[illegible]

Assessing the Software for Learning Activities. [illegible]

In another experiment, a computer graphics system, developed originally for research in quantitative chemistry, is being used as an undergraduate teaching device. This system, developed by Professor E.J. Corey, allows a chemistry student to make a thorough and sophisticated analysis of molecular structure. The synthesis of such complex organic structures usually requires a considerable number of discrete steps consisting of individual chemical reactions which together form a synthetic pathway. Structures of up to 75 atoms (not including hydrogen) may be entered into the system using a graphics (CRT) terminal with keyboard and electrostatic writing tablet. Significant chemical features are perceived and logical search processes are conducted by the system interacting with the student to find suitable chemical reactions for the assembly of the structure.

Gaming. The ability of computer-based software to store and manipulate data as well as interact with people in a number of "people oriented" ways enables the development of relatively complex games which can be used by students to play realistic roles in a simulated "real world" environment. The urban simulation game APEX has been used extensively to enable students to play the roles of urban decision makers interacting with each other about a simulated city. APEX simulates the city of Lansing, Michigan, and enables players to assume the roles of politicians, planners, developers, industrialists, and pollution control officers. The game is played in cycles which require each of the decision makers to input decisions about land development, industrial zoning, pollution regulations and the like. Players are required to negotiate with their colleagues in various roles during the decision process. The decisions are input to the computer-based game and the results for the simulated year are returned (in a few minutes) to each player telling what had happened for the city, each business, political fortunes and the state changes for each player and the city. In a paper describing the experience, one professor concludes that "...[it] promises a way of relating specific legal questions to the entire urban process - a way not dependent upon appellate cases but closely resembling the law's actual functioning on a number of levels ... [it] engages the players in decision-making and action in what Aristotle called the exercise of practical reason."[7]

In numerous Business Schools, "business games" are played competitively by individuals and teams of students in order to test business decision-making skills. Students play the role of corporate executives through a compressed series of quarterly and annual business decisions. Financial reports and other reflections of corporate status are printed by the computer system for each

7. Degnan, D. A. and Haar, C. M., "Computer Simulation in Urban Legal Studies," Journal of Legal Education, AALS, Vol. 23, 1970-71.

decision-making cycle of the game. The students, representing the corporate executives, are required to work individually and as a team in the simulated environment of competitive business.

Video materials assume several roles in these games. First, videotapes are used in some cases to present the basic situation which is being gamed. The conditions in particular parts of a city can often be represented visually with more affect than any other way, for example. Second, visual materials (although not videotape) are presented in the form of sophisticated graphics to represent outcomes of population shifts, economic factors, and the like. Third, videotapes of the games are very useful in a post mortem analysis and critique by the players as well as for introducing new players to the games.

The use of games allows heuristic processes which can, depending on the validity of the simulation, represent a cyclic but decision dependent process. These games require students to use accumulated knowledge to make critical decisions and also to interact in the decision process with other players.

SOME OBSTACLES TO CHANGE

Having argued for the opportunities of instructional technology and supported the argument with a few illustrations, pragmatism demands some treatment of the odds for changes in the instructional process. As predicted, the use of instructional technology continues to be in the category of "experimentation and development". However, the experimentation has already demonstrated some advantages of modules of technology-based teaching materials, if less clearly the role of "complete" technology-based courses. At issue is the role of technology in the improvement of the process which is demanding that more material be delivered to students in less time and at less cost. There are several areas in which some "breakthroughs" must occur before we can even move into the Carnegie Commission's category of "generally introduced" not to mention the advanced state of "generally in use".

Distribution and Access. There is a noticeable absence of a viable industry for the distribution of technology-based teaching materials. As a result, the materials are largely developed and used in a sort of "cottage industry" which centers around good technological facilities and highly motivated people working mostly in universities and colleges. There appear to be several established areas that must change as a prerequisite to any improvement. First, the book publishing industry must recognize and accept the market for technology-based supplements to printed material. Audiotapes and film strips have only a foot in the door. Computer programs are taboo. Second, libraries will have to accommodate the facilities for patrons to access the technology-based materials. The libraries, now squeezed by both the double digit inflation affecting printed materials for several successive

years (and no relief in sight) and the effect of personal income growth on their labor-intensive operations are seeking relief. However, gearing up to handle technology-based materials will undoubtedly aggravate the short term financial problem before making any contribution to the long term solution. Third, a national copyright and patent policy that motivates the development of technology-based materials without exacerbating the legal and financial problems of its use will be necessary. A good solution to this problem would do much to solve the first problem cited. A bad solution would virtually prevent any progress. Fourth, a methodology for distributing computer based material nationally is needed. Television and videotape equipment is sufficiently standard (and relatively simple) that compatibility is not the major problem that it is in computer technology. The videodisc may solve the debilitating problem of the cost of the medium which has plagued videotape. Computer technology, however, has a major problem represented by the barriers to transportability of computer program material. Sophisticated communication networks may offer a solution, particularly if distance independent pricing and low fixed cost can become widespread. If the cost/performance of communication is right, the facilitating services required to interface students and teachers to multiple remote computer resources can probably be developed.

Adequate Technological Resources. Many schools have limited technological resources. Television playback equipment and computers have been beyond their economic reach. The videodisc may help with pure video presentations. The new "intelligent terminals" (which incorporate microcomputer technology) and low cost minicomputers may be usable in combination with communication networks and larger computers to bring technology-based instructional materials within the reach of many. This kind of technological

resource system would represent not only a basis for development of materials but also a large volume market for technology-based materials.

Rewarding Authorship. The individual efforts of authors in the development of technology-based teaching materials must be encouraged by incentives. The incentives must combine professional recognition with the potential for economic reward. Unfortunately, both elements of the reward structure are currently lacking. For example, junior faculty who devote substantial time to the development of technology-based teaching materials often do so at the expense of research and thus promotion. For most disciplines, the development of computer algorithms or video presentations carries nowhere near the professional weight of a published (printed) journal article. This discourages all but the most persistent. Moreover, the condition is improving only very slowly. The financial reward structure is equally discouraging. For financial reward, one writes books, not computer programs or video productions. Perhaps this problem will also be overcome given time and the appropriate combination of solutions to the previously described problems.

[redacted]'s Approach

[redacted] was established in 1965 for the purpose of fostering the development of electric instructional resources in education. It has passed through several cycles of hope and expectation. In 1971, [redacted] began to develop the idea of a Planning Council for Computing in Higher Education and Research, an idea conceived from the ARP-sponsored conference on computer networking held at Airlie House. The idea has now transformed into an action-oriented group of twenty-two institutions that have combined money and time for a five year period to provide a "critical mass" for viable development of national computer networking.[6] The [redacted] Planning Council is directed by James Emery and is governed by a Policy Board composed of 7 senior university executives and a Technical Committee composed of senior computer scientists/administrators from the twenty-two member schools. Participating grants have been received from the Carnegie Corporation, the Alfred Sloan Foundation and the Ford Foundation. The Planning Council Facilities for attendees at three conferences:

1. Investigating the means for creating a national computer network. This started with the preparation of a plan laying out the steps necessary to move from today's fragmented, ad hoc approach to a more coherent scheme for cooperation in the sharing of computer-based resources. A prototype national network activity has already started between the Planning Council institutions with the objectives of conducting carefully designed and evaluated small-scale experiments in national networking. In addition, [redacted] group networking experiments are being developed

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6. Emery, James C., "Implementation of a Participating Research Policies, Strategies and Plans for Computing in Higher Education, Princeton, N.J. 1974

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[illegible]